PROGRAM CHARTER

FOR

Environmental Modeling

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1. EXECUTIVE SUMMARY

NOAA's mission is "to understand and predict changes in the Earth's environment and conserve and manage coastal and marine resources." The Environmental Modeling Program (EMP) is one of the cornerstones for the provision of NOAA's products and services to the nation. As part of the NOAA Modeling, Observations, and Infrastructure (MOBI) Sub-goal, EMP provides models and model-based estimates of both current and future states (at all time scales) of the Earth environment, using scientifically based modeling techniques. Through operation and maintenance of a suite of atmospheric, oceanic, hydrologic, and ecosystem models, EMP provides NOAA and its customers with accurate and timely information required to make informed decisions. EMP fosters improved modeling capability and collaboration within and between agencies and academia through a vigorous research and development program aimed at making the transition from research to operations as efficient as possible.

EMP enables NOAA to serve society's needs for weather and water information and provides critical mission support to management of the nation's coastal and ocean resources; understanding climate variability and change; and providing information in support of safe, efficient, and environmentally sound transportation. NOAA's service enterprise relies on the quality and utility of the analyses and predictions output by the models created and maintained by EMP. The program activities are located at the NWS and NESDIS Centers in Camp Springs, MD; the offices of the NOAA CIO and the NOS and NWS laboratories in Silver Spring, MD; the OAR Laboratories in Boulder, CO and Princeton, NJ; and in conjunction with our federal, state, local, and academic partners.

2. PROGRAM REQUIREMENTS

A. Requirement Drivers:

1) High Performance Computing and Communication Act of 1991, 15 U.S.C. §§ 5501-5528, at § 5524(a)(2). - The National Oceanic and Atmospheric Administration shall conduct basic and applied research in weather prediction and ocean sciences, particularly in development of new forecast models, in computational fluid dynamics, and in the incorporation of evolving computer architectures and networks into the systems that carry out agency missions.

2) Global Change Research Act of 1990, 15 U.S.C. § 2921 et seq.- This act provides for the development and coordination of a comprehensive and integrated United States research program which will assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change. Section 2932 requires the President, through the Federal Coordinating Council on Science, Engineering, and Technology, to establish a Committee on Earth and Environmental Sciences, on which NOAA, among other agencies, must have at least one representative. Under section 2938, the President, the Chairman of the Council, and the Secretary of Commerce shall ensure that relevant research activities of the National Climate Program, established by the National Climate Program Act (15 U.S.C. § 2901 et seq.), are considered in developing national global change research efforts.

3) National Weather Service Organic Act, 15 U.S.C. § 313. - Sets forth the primary duties of the National Weather Service, including the requirements that the Secretary of Commerce shall: forecast the weather; issue storm warnings; display weather and

flood signals for the benefit of agriculture, commerce, and navigation; gauge and report the flow of rivers; maintain and operate the seacoast telegraph lines and collect and transmit marine intelligence for the benefit of commerce and navigation; report temperature and rain-fall conditions for the cotton interests; display of frost and cold-wave signals; distribute meteorological information in the interests of agriculture and commerce; and take the meteorological observations that may be necessary to establish and record the climatic conditions of the United States, or that are essential for the proper execution of the foregoing duties.

4) Hydrographic Services Improvement Act of 1998, 33 U.S.C. § 892 et seq. - This Act clarifies some of the responsibilities and authority of the NOAA Administrator for NOAA navigation programs. The Act directs that NOAA shall acquire and disseminate hydrographic data, promulgate standards for such data and services (and help develop international standards), ensure comprehensive geographic coverage of hydrographic services, maintain a national database of hydrographic data, and provide hydrographic services in uniform and easily accessible formats, by contracting with private entities and other appropriate means. 33 U.S.C. § 892a(a). It provides that the Administrator, to fulfill these functions, may procure equipment, vessels, and technology necessary to ensure safe navigation and maintain expertise, and may enter into contracts and other agreements with qualified entities. It authorizes the Administrator to design and install the Physical Oceanographic Real Time Systems (PORTS) where appropriate.

5) Coast and Geodetic Research Act, 33 U.S.C. §§ 883a - 883i. - This Act provides the basis for NOS navigation service programs. Sec. 883a authorizes the Secretary of Commerce to conduct hydrographic and topographic surveys, tide and current observations, geodetic-control surveys, field surveys for aeronautical charts, and geomagnetic, seismological, gravity, and related geophysical measurements to provide charts and other information for safe marine and air navigation. This information is collected, analyzed, assimilated, and distributed by DOC. The National Ocean Survey [NOAA] is designated as the central depository for geomagnetic data, and the Secretary is authorized to collect, correlate and disseminate such data. The Act authorizes the Secretary to conduct developmental work for the improvement of surveying and cartographic methods and instruments and to conduct investigations and research in geophysical sciences. The Secretary is authorized to enter into cooperative agreements with states, federal agencies, public or private organizations or individuals, for surveying, mapping and publication activities, and to contract with qualified organizations for National Geodetic Survey functions. The Act provides for a permanent authorization of appropriations. The language in the Act is generally permissive: The Secretary is “authorized” to do various functions. But the statute, passed in 1947, stated as it purpose “To define the functions and duties of the Coast and Geodetic Survey, and for other purposes.” And the nature of the functions and duties (examples include mapping of coastal areas; observance, analysis and prediction of tide and current data; serving as a central depository of the U.S. Government for geomagnetic data) indicates these activities are more than discretionary. By Department Organization Order 25-5A (now found in DOO 10-15), the Secretary designated his functions under this authority to the NOAA Administrator. Public Law 106-181, 49 U.S.C. § 44721.

6) The Oceans and Human Health Act, 33 U.S.C. §§ 3101 - 3104 – This act establishes a national research program to improve understanding of the role of the oceans in human health, including the development through partnerships among Federal agencies, States, or academic institutions of new technologies and approaches for detecting and reducing hazards to human health from ocean sources, interdisciplinary research and activities to improve understanding of processes within the ocean that may affect human health, and the development of predictive models based on indicators of marine environmental health or public health threats.

7) International or inter-agency cooperation developed bilateral or multilateral requirements documents (e.g. Memorandum of Understanding) as applicable.

   a) Strategic plan for the Climate Change Science Program (CCSP): requires reduced uncertainty in projections of how the Earth's climate and related systems may change in the future.

   b) Participating member of World Meteorological Organization (WMO) and support for products and services delivered to the WMO World Weather Information Service.

   c) Partner with other agencies (e.g. DOD – Navy, Air Force, DOT, DOE, FAA) and academic institutions on prediction requirements and modeling collaborations (e.g. Joint Center for Satellite Data Assimilation, Earth System Modeling Framework effort, Weather Research and Forecasting (WRF) group, Surface Transportation working group)

B. Mission Requirements:

1) Provide models and model related products and services which integrate science and environmental understanding and prediction capabilities across NOAA mission goals, programs, and activities.

   a) High Performance Computing and Communication Act of 1991.

2) Provide model based forecast guidance products to advance decision support services, aid forecasters, educate stakeholders, and prevent loss of life, injury, and damage to the economy resulting from environmental conditions and events.

   a) National Weather Service Organic Act.

3) Provide models and model based products capable of defining requirements for research, improving observational platform design, and incorporating all available scientific information (observations, knowledge, etc.) to enhance environmental predictability.

   a) High Performance Computing and Communication Act of 1991.

4) Provide the research environment and computational infrastructure necessary to meet operational and research computing needs and to effectively transition demonstrated research successes and advancements into operations.

   a) High Performance Computing and Communication Act of 1991.

5) Provide computer simulations and predictive models of ecosystems to improve resource management and ensure the sustainable use of resources and to balance competing uses of coastal and marine ecosystems.

   a) Oceans and Human Health Act.

6) Provide models and model based estimates of the climate system capable of improving the quantification and understanding of the forces bringing about climate change and predicting the consequences of climate change on ecosystems; and providing sound scientific support for informed decision making.

   a) Global Change Research Act of 1990.

7) Provide models and model based products to support sound decisions on aviation, marine, and surface navigation efficiencies including model based nowcasts and forecasts of water levels, currents, and tides; and models and information leading to enhanced aviation safety and economy.

   a) Hydrographic Services Improvement Act of 1998 and the Coast and Geodetic Research Act.

3. LINKS TO THE NOAA STRATEGIC PLAN

A. Goal Outcomes: EMP supports all four of the major mission goals via advanced modeling, prediction, and assessment of Earth's environment. Specific outcomes for each mission goal include:

1) Ecosystem Mission Goal Outcome: Healthy and productive coastal and marine ecosystems that benefit society.

2) Climate Mission Goal Outcome: A predictive understanding of the global climate system on time scales of weeks to decades with quantified uncertainties sufficient for making informed and reasoned decisions.

3) Weather and Water Mission Goal Outcomes: Reduced loss of life, injury, and damage to the economy; Better, quicker, and more valuable weather and water information to support improved decisions.

4) Commerce and Transportation Mission Goal Outcome: Safe, secure, and seamless movement of goods and people in the U.S. transportation system.

B. Goal Performance Objectives: To appropriately support the above mission goal outcomes, EMP employs the strategies listed in the next section to pursue the following performance objectives:

1) Ecosystem Mission Goal:

a) Increased number of coastal communities incorporating ecosystem and sustainable development principles into planning and management.

2) Climate Mission Goal:

a) Improved climate predictive capability from weeks to decades, with an increased range of applicability for management and policy decisions.

b) Reduced uncertainty in climate projections through timely information on the forcing and feedbacks contributing to changes in the Earth's climate.

c) Predicted the consequences of climate variability and change on marine ecosystems.

d) Increased number and use of climate products and services to enhance public and private sector decision making.

3) Weather and Water Mission Goal:

a) Increased lead time and accuracy for weather and water warnings and forecasts.

b) Improved predictability of the onset, duration, and impact of hazardous and severe weather and water events.

c) Increased development, application, and transition of advanced science and technology to operations and services.

d) Reduced uncertainty associated with weather and water decision tools and assessments.

4) Commerce and Transportation Mission Goal:

a) Enhanced navigational safety and efficiency by improving information products and services.

b) Reduced weather-related transportation crashes and delays.

C. Goal Strategies: EMP employs the following mission goal strategies to support mission goal performance objectives and outcomes by:

1) Ecosystem Mission Goal:
   a) Managing uses of ecosystems by applying scientifically sound observations, assessments, and research findings to ensure the sustainable use of resources and to balance competing uses of coastal and marine ecosystems.
   b) Improving resource management by advancing our understanding of ecosystems through better simulation and predictive models.
2) Climate Mission Goal:
   a) Improving the quantification and understanding of the forces bringing about climate change by examining relevant human-induced increases in atmospheric constituents.
   b) Advancing sub-seasonal to inter-annual climate predictions and climate change projections by improving analyses of the climate system, using ensembles of multiple, high-end climate and Earth models.
   c) Developing the ability to predict the consequences of climate change on ecosystems by monitoring changes in coastal and marine ecosystems, conducting research on climate-ecosystem linkages, and incorporating climate information into physical-biological models.
   d) Developing and contributing to routine state-of-the-science assessments of the climate system for informed decision making.
3) Weather and Water Mission Goal:
   a) Improving the reliability, lead-time, and effectiveness of weather and water information and services that predict changes in environmental conditions.
   b) Developing and infuse research results and new technologies more efficiently to improve products and services, streamline dissemination, and communicate vital information more effectively.
   c) Working with private industry, universities, and national and international agencies to create and leverage partnerships that foster more effective information services.
   d) Employing scientific and emerging technological capabilities to advance decision-making support services and educate stakeholders.
4) Commerce and Transportation Mission Goal:
   a) Developing and applying new technologies, methods, and models to increase the capabilities, efficiencies, and accuracy of transportation-related products and services.
   b) Developing and implementing sophisticated assessment and prediction techniques, products, and services to support decisions in aviation, marine, and surface navigation efficiencies; coastal resource management; and transportation system management, operations, and planning.

4. PROGRAM OUTCOME(S)

A. Provide requisite environmental information and predictions to meet the operational requirements of NOAA's service programs as well as federal, state, local, and commercial partners.

B. Develop testing to efficiently transition research into NOAA's operational NOAA's products and services to stakeholders.

C. A NOAA observing system architecture and design tailored to environmental modeling needs

5. PROGRAM ROLES AND RESPONSIBILITIES

This program is established and managed with the procedures established in the NOAA Business Operations Manual (BOM). Responsibilities of the Program Manager are described in the BOM. Responsibilities of other major participants are summarized below:

A. Participating Line Office, Staff Office, and Council Responsibilities:

1) Office of Oceanic and Atmospheric Research: Modeling techniques research and development, WRF Development; WRF Rapid Refresh Development; WRF-Chem Development; Climate and Earth System model Development; Global atmospheric modeling reseach; manage and operate R&D Supercomputing.

2) National Ocean Service: Coastal and Estuarine Model Development and Operation in support of Commerce and Transportation; coastal and marine ecosystem forecast model development and operations; coastal marine product development; tidal, storm surge, and sea level rise model development.

3) National Environmental Satellite Data and Information Service: Operational Processing and Delivery of Satellite Data; Satellite Data Assimilation Research and Development.

4) National Weather Service: Operational Numerical Weather Prediction operations and maintenance, including data assimilation systems; global and regional models and post-processing; operational weather, water, short-term climate, coastal hazards, and air quality model development; objective post processing development and implementation; advanced data assimilation technique development; manage and operate Weather and Climate Supercomputing Center.

5) Office of the NOAA Chief Information Officer: Manage High Performance Computing and Communications Program including: advancing numerical and computing techniques development; chairing the NOAA High Performance Computing Board; overseeing and supporting acquisition and management of NOAA's HPC Resources; and exploring advanced information technologies and transfer successes to improve NOAA mission outcomes.

6) NOAA General Counsel: The NOAA Office of General Counsel (GC) is responsible for providing legal services necessary to enable the program to discharge its duties. In this regard, NOAA GC provides a variety of specific services on an as-needed basis, including but not limited to: advice on legal issues related to program responsibilities; review and clearance of agreements, testimony, correspondence, and other documents; legal representation; assistance with litigation and requests for testimony or information; and coordination on behalf of the program with the Department of Commerce GC in the areas of contract, grant, intellectual property, labor and employment, appropriations, legislation and regulation, grant, litigation, and telecommunications law.

7) Administrative Services: Responsible for providing administrative support for grants.

8) Facilities: Responsible for providing a safe and productive work environment.

9) The NOAA Ocean Council (NOC): The NOC is established as the principal advisory body to the Administrator and coordination body for the agency's ocean activities and interests, including open ocean, near shore, coastal, estuarine and Great Lakes activities. The NOC is also authorized to develop a strategy and serves the agency focal point for responding to and implementing the recommendations of the President's Ocean Action Plan.

10) Other NOAA's Councils (e.g., Observing System and Research) are responsible for providing policy guidance and frameworks within which the Environmental Modeling Program can operate to resolve issues in observations, and in modeling technique

research and development for the future NOAA Earth Modeling System.

B. Other NOAA Programs

1) Science and Technology Infusion Program: Funds research and development necessary to use WSR-88D operationally in models; funds development of the Hurricane WRF Modeling Components.

2) Air Quality Program: Funds Air Quality modeling research and development; funds Air Quality high performance computing requirement.

3) Climate Research and Modeling Program: Funds climate and Earth System modeling research and development; funds high performance computing requirement for CCSP-related research and projections.

4) Coasts, Estuaries, and Oceans: Funds integrated ocean observations through IOOS; promotes partnerships through federal, state, local, academic, and private industry to foster R&D and transition to operations.

5) Emergency Response Program: Funds research and development and transition to operations to provide forecasts of the fate and transport of oil and other hazardous materials.

C. External Agency/Organization Responsibilities (e.g., EPA, Fish and Wildlife Service, state agencies, international partners, private sector organizations):

1) NASA: Partners with NOAA in the Joint Center for Satellite Data Assimilation and Funds the Earth System Modeling Framework Development.

2) DOD : WRF Program partner; partners with NOAA in the Joint Center for Satellite Data Assimilation; ESMF development partner; National Unified Operational Prediction Capability (NUOPC) partner.

3) DOE: ESMF development partner

4) FAA: WRF Program Partner

5) NCAR: WRF Program Partner; ESMF Development Partner

6. END USERS OR BENEFICIARIES OF PROGRAM

A. NOAA Mission Goals and Programs:

1) Ecosystems:

a) Ecosystems Research

b) Ecosystems Observations

2) Climate: Assimilation and modeling capabilities; predictions and projections.

a) Climate Observations and Monitoring

b) Climate Research and Modeling

c) Climate Service Development

3) Weather and Water: Assimilating, specifying, and analyzing; prediction; Researching and understanding.

a) Local Forecasts and Warnings

b) Coasts, Estuaries, and Oceans

c) Hydrology

d) Air Quality

e) Weather and Water Science Technology and Infusion

4) Commerce and Transportation: Scientific analysis and tools; models; and services.

a) Marine Transportation Systems

b) Aviation Weather

c) Marine Weather

d) NOAA Emergency Response

e) Surface Weather

5) Information Technology capabilities (goal wide): Environmental Modeling supercomputing resources will be managed in a way which integrates architectures to support timely and effective science and technology infusion.

6) Research Crosscut: Environmental Modeling will research, develop, and maintain a cutting edge scientific infrastructure; particularly to support data analysis, modeling and prediction advances.

B. Academia – the program awards extramural research grants to study impacts to coral reef ecosystems. The program awards extramural grants to study means of improving environmental modeling using new techniques and satellite observations. There are numerous University customers of the inter-agency Earth System Modeling Framework (ESMF), including numerous academic collaborators who work with Program scientists on the development of environmental models.

C. General Public: Enable improved forecasts and warnings

1) Forecasts and warnings reduce avoidable death, injury, and property loss by delivering additional advance notice to the public and other agencies for local hazardous weather including tornadoes, hurricanes, floods, coastal water levels, drought, and intense winter storms over both land and oceans.

2) Precipitation forecasts enhance stewardship and management of inland and offshore water resources, allowing water resource managers to optimize the use of our inland and coastal waters and minimize adverse impacts due to floods and droughts.

3) Forecast products improve the safety and efficiency of maritime, inland waterways, and Great Lakes commerce and utilization; and provide important information for maintaining and restoring environmental quality and improving fisheries management.

4) Weather forecasts and products and service dissemination promotes safe and efficient transportation on land, at sea, and in air.

5) Forecasts of space weather events, such as geomagnetic storms and solar flares, allow better management of satellite operations, power generation networks, and satellite communication networks; and resulting mitigation efforts will reduce expensive damage to these systems.

6) Accurate assessments of future environmental conditions beyond a few days provide increases in economic efficiency and planning information for activities over land and water

7) Ecological forecasts allow resource managers to solve resource management problems, lead to sustainable decisions about ecosystem productivity, reduce the impacts from extreme natural events and human activities, and focus scientific research and monitoring priorities.

D. Federal Partners:

1) FAA: NOAA activities supporting the FAA Aviation Weather Research Program and its

centers include:

a) Developing and testing new aviation weather computer models, including the Rapid Update Cycle (RUC), the “Eta”, WRF-NAM, and WRF Rapid Refresh models.

b) Creating the Real-Time Verification System (RTVS) which is used to measure the quality of aviation weather forecasts of thunderstorms, ceiling and visibility, precipitation amount, wind direction and speed, icing, and turbulence provided by weather models and programs and by human forecasters at the Aviation Weather Center.

c) Developing forecaster tools similar to a NWS forecaster workstation (FX-Net; FX-Collaborate) that let everyone see the same information (called "shared situational awareness") and the same version of aviation weather products for users in the FAA and the National Weather Service.

d) Developing and installing (along with NCAR) the Aviation Digital Data Service (ADDS)

e) Operating a Federal Aviation Administration Test Bed (FAATB) in support of Aviation Forecast PDT projects such as the National Convective Weather Forecast (NCWF), the Current Icing Potential (CIP) and the Forecast Icing Potential (FIP), the Graphical Turbulence Guidance (GTG), and ceiling and visibility (C&V) forecasts.

2) FEMA and the US Army Corps of Engineers: NOAA supports Federal, state, and local efforts in comprehensive hurricane evacuation planning by providing estimates of potential storm surge flooding for various category hurricanes through simulation studies. In addition, operational storm surge model runs are produced starting 24 hours before projected landfall and ending as surge begins to subside. Various products are provided to FEMA, emergency managers, and NWS coastal forecasters. Coordination of this work is done through the Interdepartmental Coordination Committee on Hurricanes (ICCOH).

3) U.S. Navy: Cooperative research and development on ocean, coastal, and regional modeling; data assimilation; the Earth System Modeling Framework; and scientific visualization and product development.

4) Networking and Information Technology Research and Development (NITRD) Program: Collaboration of more than a dozen Federal research agencies working together towards the goal of U.S. leadership in science, engineering, and technology through advanced information technology. The NITRD Program is the Nation’s primary source of revolutionary breakthroughs in advanced information technologies such as computing, networking, and software.

5) NASA: Houses NOAA supercomputer assets at its Independent Verification and Validation Facility in Fairmont, West Virginia.